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RESEARCH PAPER

Effects of pre-sowing treatments on seed germination of *Melia azedarach*

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Abstract: A germination experiment of pre-treated seeds of *Melia azedarach* was conducted in the nursery of Forestry and Wood Technology Discipline, Khulna University, Bangladesh. Matured seeds of *Melia azedarach* were collected from healthy trees of National Botanical Garden, Bangladesh and were treated with five pre-sowing treatments (control, immersion in cold water, immersion in hot water, scarification with sand paper, and immersion in concentrated H_2SO_4) on seed germination. Results revealed that the germination rates of pre-sowing treated seeds were significantly increased compared to those in control, except for cold water treatment. The highest germination success (80%) was found in scarification with sand paper, followed by 74% and 69% in immersion in H_2SO_4 and hot water treatment, respectively. Germination started on 8–11 days and completed on 20–21 days of the germination period in all cases. Analysis of variance showed the significance difference in germination success among the treatments but no significance difference in germination period among the treatment. Hot water treatment may be recommended on seed germination of the species in rural Bangladesh.

Keywords: germination; *Melia azedarach*; pre-sowing treatment; seed

Introduction

Seeds provide an indispensable link in population dynamics by allowing the establishment of new individuals and so the founding of population (Rees 1996). However, seed dormancy interrupts the process (Schmidt 2000). Seed dormancy is a phase of the occurrence of growth cessation which has as its crucial point the problems of preserving a potential for growth without loss of biological integrity (Amen 1968). Seed dormancy sometimes causes to fail seed germination, even when the conditions are apparently favourable for seed germination (Rolston 1978). There are various kinds of dormancy in which mechanical dormancy limits to maturity of embryo may be decreased either by regular softening of the enclosing seed coat or pericarp (Bachelard 1967). Physical dormancy is caused due to water-resistant seed coat or fruit enclosure which stops imbibitions and sometimes also gaseous exchange. Physical dormancy may be overcome either by manual scarification of the seed-coat by piercing, nicking, clipping, filing or burning with the aid of knife, needle, hot wire burner, abrasion paper (Catalan and Macchiavelli 1991); hot water treatment (Kobmoo and Hellum 1984; Khasa 1992) or acid treatment (Kobmoo and Hellum 1984). Among the pioneer forest tree species, photo-dormancy is a common phenomenon. In practices photo-dormancy can not be overcome by the application of seed pretreatment but seed germination under suitable light conditions can break the dormancy (Teketay 1996). Seed having thermo-dormancy needs exposure to a temperature regime that is often different from that required for definite germination process. Thermo-dormancy can be partially or completely overcome by chemical treatments in some instances (Palani et al. 1995). Seed treatment by soaking in stagnant or running water can leach out chemical inhibitors in fruits and seeds (Yadav 1992).

M. azedarach, a member of the family *Meliaceae*, is a moderate deciduous tree with a short bole and a spreading crown, bipinnate or tri-pinnate leaves and a dark grey bark with shallow longitudinal furrows (Troup 1921). It is popular for its showy clusters of pale purplish spreading flowers and the shade of its dense, dark green foliage in summer. The tree is closely related to the *Azadirachta indica* that differs in having longer leaflets, white flowers, and a more spreading open crown (Zabala 1990). *M. azedarach* an attractive fast-growing tree thrives in a variety of soils, and the species is cold-hardy and drought-resistant. The wood of this species is very hard and durable. In Bangladesh it is

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widely used in home garden, road side plantation both in public and private plantation programs. Plantations of *M. azedarach* tree improve the environmental condition of the country. *M. azedarach* is also well-known for its medicinal value. Lately this plant has emerged as a source of several potent botanical insecticides. The drought tolerant *M. azedarach* helps to reduce soil erosion and produces soap, lamp oil, lubricants and lumber. It is also a good shade tree. Different parts like bark, leaf, seeds, root of M azedarach have very strong medicinal value and the seeds of this species can also be used as biological control of fungicide and pesticide of agricultural crops. The timber of this species is very important for furniture industry and it can also meet the demand of fuel wood in Bangladesh. Therefore, it can be introduced in all over the country. However, seed germination of the species is very poor due to seed dormancy. Seed treatment is to ensure fast and uniform germination (Azad et al. 2006a). The effects of pre- treatments on seed germination of some tropical forest tree species have been reported by Ahamed et al. (1983), Matin and Rashid (1992), Bharwas and Chakraborty (1994), Ali et al. (1997), Koirala et al. (2000), Khan et al. (2001), Alamgir and Hossain (2005a; 2005b), Azad et al. (2006a; 2006b) and Matin et al. (2006). But information on the effect of *M. azedarach* seed pretreatment is ignored. Deprived seed germination and late nursery establishment restricts the extensive cultivation both in forestry and home garden plantation programs (Alamgir and Hossain 2005b; Azad et al. 2006a & 2006b). Suitable presowing techniques of seed germination can enhance germination rate and over all process (Koirala et al. 2000; Alamgir and Hossain 2005a; 2005b; Azad et al. 2006a; 2006b). Thus the objective of the study was to determine the optimum pre-treatment methods that maximized germination percentages.

Materials and methods

The experiment was conducted in the nursery of Forestry and Wood Technology Discipline, Khulna University, Bangladesh. The seeds were collected manually from matured, healthy 25 to 30 years old trees from National Botanical Garden at Mirpur, Dhaka, Bangladesh in April 2005. The seeds were dried for four to five days in open sun to reduce the moisture after collection. The seeds were then separated manually from the drupe and dried again in the sun for another week. The collected seeds were checked to remove the discolored, damaged seeds. Healthy dried seeds were used for the experiment. The germination test was done by sowing the seeds in poly bags (4 cm × 6 cm). The media of the poly-bags was topsoil, coconut husk compost, coarse sand and fine sand in the ratio of 3:4:1:1. Five treatments were set in the experiment, i.e., treatment 1: control, treatment 2: immersion in cold water (4°C) for 12 h, treatment 3: immersion in hot water (80°C) for 10 min, treatment 4: scarification with sand paper, treatment 5: immersion in concentrated H_2SO_4 (80%) for 20 min. One seed was sown in each poly bag. Poly bags were kept in shade throughout the experiment. The seeds were sown in the depth of 0.5−1.5 cm and watering was done manually once a day. Randomized Block Design (RBD) with four replications was used for the experiment. A total 80 (4 x 20) poly bags were used for each treatment. Therefore, the total numbers of poly bags were 400 (5 x 4 x 20). Analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT) (Duncan 1955) were carried out to analyze the data. Data were analyzed using MS Excel and Statistical software (version 7.0.61.0.EN). The experiment was done in April – May 2005. The temperature and humidity were recorded 33.42°C and 88.60%, respectively, in the poly bags. The number of seeds germinated in each treatment was recorded every alternate day. The starting and finishing dates of germination were also recorded.

Results

Morphological characteristics of the *M. azedarach* seeds

The fresh seeds of *M. azedarach* were yellowish in color. However, the dry seeds were whitish. The average length, breath and thickness of the seeds were of 1.26 ± 0.002, 0.589 ± 0.008 and 0.78 ± 0.089 cm, respectively. There were 700−800 seeds per kilogram.

Seed germination

Germination success of the seeds in different treatments and the cumulative germination success (%) were shown in the Fig. 1 and Fig. 2, respectively. The highest germination success (80%) in scarification with sand paper differed significantly (p<0.01) with the lowest germination success (39%) in cold water treatment. Germination in scarification (80%), immersion in H_2S0_4 (conc.) for 10 min (74%), hot water treatment (69%) showed no significant difference (p>0.05) with each other. But all the treatments differed significantly (p<0.05) with control (48%) (Table 1).

Table 1. Germination percentage of the *M. azedarach* seeds under five pre-sowing treatments in polybag

Treatments	Period (day)			Mean germination (%) per week
	Start	Cease	Total	
Treatment 1 (T1)	10	21	11	48
Treatment 2 (T2)	11	20	9	39
Treatment 3 (T3)	9	20	11	69
Treatment 4 (T4)	10	21	11	80
Treatment 5 (T5)	8	20	12	74

1: Control, T2: Immersion in cold water (4°C) for 12 h, T3: Immersion in hot water (80°C) for 10 min, T4: Scarification with sand paper, T5: immersion in concentrated H_2SO_4 (80%) for 20 min

Germination started first on 8th day during the germination period in immersion in H_2S0_4 (conc.) treatment, on 9th day in hot water treatment, on 10th day in control and scarification with sand paper treatment, on 11th day in cold water treatment. In all treatments, germination completed within 20−21 days after sow-

ing the seeds in the polybags (Table 1). Analysis of variance showed significant difference ($p< 0.01$) in germination success (%) among the seed treatments but no significance difference ($p> 0.05$) in germination period among the treatments. Duncan Multiple Range Test (DMRT) showed no significant difference of seed germination among hot water treatment, scarification with sand paper treatment, and H_2So_4 treatment. But they differed significantly with control and cold water treatment. It also showed there was significant difference between control and cold water treatment (Table 2).

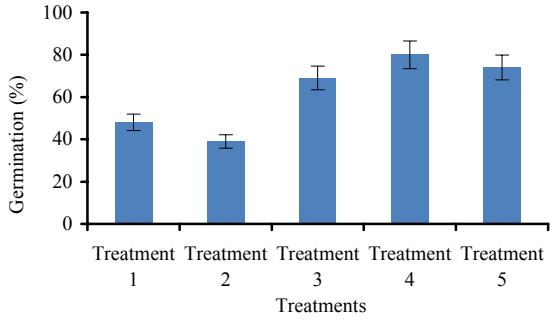

Fig. 1 Germination success (%) of *M. azedarach* seeds under five pre-sowing treatments in polybag. T1: Control, T2: Immersion in cold water (4°C) for 12 h, T3: Immersion in hot water (80°C) for 10 min, T4: Scarification with sand paper, T5: immersion in concentrated H_2SO_4 (80%) for 20 min.

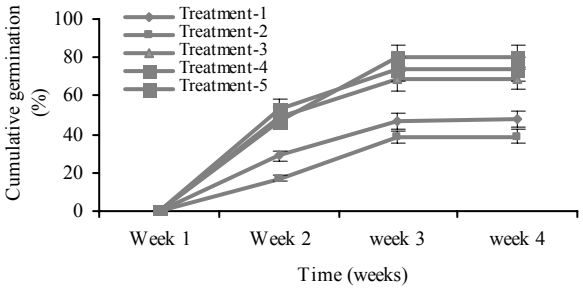

Fig. 2 Cumulative germination (%) throughout the germination period of *M. azedarach* under five pre-sowing treatment in polybag. T1: Control, T2: Immersion in cold water (4°C) for 12 h, T3: Immersion in hot water (80°C) for 10 min, T4: Scarification with sand paper, T5: immersion in concentrated H_2SO_4 (80%) for 20 min.

Table 2. Rank of different treatment means of *M. azedarach* seeds from DMRT (Duncan Multiple Range Test). The same alphabet along the column indicates no significance difference.

Treatments	Mean germination (%) per week	Rank
Treatment 4 (T4)	20	a
Treatment 5 (T5)	18.5	a
Treatment 3 (T3)	17.25	a
Treatment 1 (T1)	12	b
Treatment 2 (T2)	9.75	c

T1: Control, T2: Immersion in cold water (4°C) for 12 h, T3: Immersion in hot water (80°C) for 10 min, T4: Scarification with sand paper, T5: immersion in concentrated H_2SO_4 (80%) for 20 min.

Discussion

Several authors argued that pre-sowing treatment of seeds can break the seed dormancy and thereby enhance the germination rate and promote the germination process. The findings of the present study also showed that seeds of M. *azedarach* under different treatments enhanced germination percentages significantly. However, seed dormancy has species specificity and varies with stage of seed maturity and degree of seed drying. Thus pre-treatment must be adjusted on the basis of the status of seed dormancy. Catalan and Macchiavelli (1991) mentioned that physical seed dormancy may be overcome either by manual scarification of seed-coat by piercing, nicking, clipping, filing or burning with the aid of knife, needle, hot wire burner, abrasion paper. Similarly hot water treatment (Kobmoo and Hellum 1984; Khasa 1992; Airi et al. 2009) or acid treatment (Kobmoo and Hellum 1984) can also overcome physical seed dormancy. Several studies have demonstrated that pre-sowing treatments improved germination of the seeds with hard seed coat (Kariuki 1987; Palani et al. 1996; Hossain et al. 2005), whereas the untreated drupes germinated slowly and irregularly (Jackson 1994; Hossain et al. 2005).

In the present study, scarification with sand paper showed the best germination (80%) among the five pre-treatments of seeds. The second, third and fourth highest germination was found in concentrate H_2SO_4 (74%), hot water (80°C; immersion 10 min) (69%) (69%) and control condition (48%). The lowest germination (39%) was found in cold water treatment. DMRT analysis showed that there were no significant difference among the treatments of scarification with sand paper, H_2SO_4, and hot water. A thinned outer coat of the seeds might contribute to the similar germination pattern. Azad et al. (2006b) carried out an experiment of pre-sowing treatment *Xylia carrii* seeds in Bangladesh, and they found a similar result of seed germination (84%) in 80% concentrated H_2SO_4 for 20 min. Ali et al. (1997) found 43% seed germination of *Albizia procera* in hot water treatment (50°C and boiling 3 min). Alamgir and Hossain (2005b) found 50% and 20% seed germination of *A. saman* in nail clipping and hot water treatment (boiling 1 min), respectively. The difference of seed germination success may be due to the variation of boiling time and temperature applied. Azad et al. (2006b) found 52% seed germination of *A. lebbeck* in hot water treatment (80°C for 10 min), which may be due to seed coat variation.

Conclusion

Melia azedarach is an important tree species for social forestry programme and also well known for its medicinal values. Thus the species is very interesting to the researchers to determine appropriate seed germination techniques. Among the five pre-sowing treatments, scarification with sand paper, acid treatment and hot water immersion performed very well seed generation for the species, without significant difference in seed germina-

tion among the three treatments. However, the use of sulphuric acid and scarification techniques are somewhat risky and troublesome. On the other hand, seed germination under hot water treatment is quite simple and inexpensive. Therefore, it is suggested to apply hot water treatment on seed germination for *M. azedarach* in rural Bangladesh.

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